multivectorial magnetizations with widely different initial NRM inclinations. However, after alternating field demagnetization, well-defined characteristic components with upward inclinations are defined.

IRM acquisition experiments, comparison of IRM and NRM coercivity spectra, and the single-component magnetization of the andesitic rocks indicate the occurrence of Fe-rich titanomagnetites of single or pseudosingle domain states as the dominant magnetic carriers. Mean inclinations from the andesitic rocks and most of the breccia samples give a mean inclination of about -40 to -45, indicating a reverse polarity for the characteristic magnetization that is consistent with geomagnetic chron 29R, which spans the KT boundary. The inclination is also consistent with the expected value (and corresponding paleolatitude) for the site estimated from the reference polar wander curve for North America. We suggest that the characteristic magnetizations for the andesitic and breccia rocks are the result of shock heating at the time of formation of the impact structure and that the age, polarity, and paleolatitude are consistent with a time at the KT boundary.

Recently, we have acquired samples from well Yucatan 6 from three different intervals [(N9, N17 (depth: 1295.5–1299 m), and N19 (depth: 1377–1379.5 m)]. We are currently determining their paleomagnetic signature.

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SUPERNOVAE AND MASS EXTINCTIONS. S. van den Bergh, Dominion Astrophysical Observatory, National Research Council, 5071 West Saanich Road, Victoria BC V8X 4M6, Canada.

Shklovsky [1] and others have suggested that some of the major extinctions in the geological record might have been triggered by explosions of nearby supernovae. The frequency of such extinction events will depend on the galactic supernova frequency and on the distance up to which a supernova explosion will produce lethal effects upon terrestrial life. In the present note it will be assumed [2] that a killer supernova has to occur so close to Earth that it will be embedded in a young, active, supernova remnant. Such young remnants typically have radii $\lesssim 3$ pc (1×10^{19} cm).

Larger (more pessimistic?) killer radii have been adopted by Ruderman [3], Romig [4], and by Ellis and Schramm [5]. From observations of historical supernovae, van den Bergh [6] finds that core-collapse (types Ib and II) supernovae occur within 4 kpc of the Sun at a rate of 0.2 ± 0.1 per century. Adopting a layer thickness of 0.3 kpc for the galactic disk, this corresponds to a rate of $\sim 1.3 \times 10^{-4}$ supernovae pc^{-3} g.y.$^{-1}$. Including supernovae of type Ia will increase the total supernova rate to $\sim 1.5 \times 10^{-4}$ supernovae pc^{-3} g.y.$^{-1}$. For a lethal radius of R pc the rate of killer events will therefore be $1.7\ (R/3)^3 \times 10^{-2}$ supernovae per g.y. However, a frequency of a few extinctions per g.y. is required to account for the extinctions observed during the phanerozoic. With R (extinction) ~ 3 pc, the galactic supernova frequency is therefore too low by 2 orders of magnitude to account for the major extinctions in the geological record.

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DISSECTING THE KT EXTINCTION: COMPONENTS AND COMPARISONS WITH THE PERMO-TRIASSIC AND "MODERN" MASS EXTINCTIONS. P. D. Ward, Mail Code AJ-20, Department of Geological Sciences, University of Washington, Seattle WA 98195, USA.

The KT extinction can now be differentiated into a number of separate components, or phases, equivalent in some ways to the steps of Earl Kauffman (1988). The initial phase commenced in the marine realm at the base of the *A. mayaroensis* zone in equatorial regions, and perhaps later in high latitudes. The major taxa affected were inoceramid bivalves, the reef facies, and other benthic mollusks. This phase coincided with (and was probably caused by) oceanographic changes including differences in ocean water oxygenation and a sea-level drop of great magnitude. The second pulse occurred at the KT boundary, and was far greater in magnitude, producing the extinction of all ammonites and a majority of planktonic foram and nannofossil species. The final phase was a benthonic foram extinction during the Paleocene. On land, the initial pulse was evidenced by floral and perhaps terrestrial vertebrate extinctions, with a greater pulse coinciding with the KT boundary. It is not known if the precursor pulses on land and in the oceans were synchronous.

The Permo-Triassic extinctions also show pulses of extinction. New work in the Karoo Series of South Africa shows three major pulses of extinction among land vertebrates, which, like KT, may or may not coincide with extinctions in the marine realm.

Finally, many workers now believe that we have entered a new period of mass extinction. This extinction began 2 m.y. ago with marine mollusk extinctions. Its second phase occurred during the last 50,000 yr with mammalian and avian extinctions. Its major pulse can be expected to occur within the next 500 yr, coincident with human population maxima.

Omit to END

CATASTROPHIC ALAMO BRECCIA, UPPER DEVONIAN, SOUTHEASTERN NEVADA. J. E. Warme, Department of Geology and Geological Engineering, Colorado School of Mines, Golden CO 80401, USA.

An anomalous sedimentary deposit, informally named the Alamo Breccia after the local settlement of Alamo in southeastern Nevada, occurs as a single bed in the Upper Devonian. It is interpreted as a gigantic debris flow and turbidite generated by a shallow-water landslide. It is anomalous because it formed upon the surface of a long-lived carbonate platform and not just at the platform edge.

To date, the Alamo Breccia has been identified in seven mountain ranges, covering an area of about 50 × 150 km (7500 km^2). Before tectonic shortening by thrust faulting, the area may originally have been greater. Thickness of the Alamo Breccia ranges from ~30–130 m, averaging 80 m; a conservative volume estimate is 600 km^3.

All evidence indicates that the Breccia was deposited as a single event, probably within a day. It is dated by conodonts as early Frasnian, or the early part of the early Late Devonian, approximately 375 m.y. ago (Sandberg and Warme, 1993). The composition of the Alamo Breccia is almost entirely platform limestone and dolomite, except in some locations where it is secondarily partially or completely dolomitized. Fragments represent the spectrum of carbonate